

## GIS Algorithm for Assigning Flow Regime

There are three categories of flow regimes that can be assigned for Arizona waters:

- **Perennial** | Surface water flowing continuously year-round
- **Intermittent** | Surface water flowing continuously during certain times of the year and more than in direct response to precipitation
- **Ephemeral** | Surface water flowing or pooling only in direct response to precipitation

Flow regimes are assigned to either the entire length of the surface water or to a portion of the surface water. Some surface waters are divided into sections, also known as reaches. According to the U.S. Geological Survey (USGS), a reach is a section of a stream or river along which similar hydrologic conditions exist. Each reach receives a Waterbody Identification (WBID) number. The WBID is then assigned a flow regime.

ADEQ developed an algorithm that can be applied to a Geographic Information System (GIS) to analyze available credible flow related data and observations for a WBID to assign a flow regime. This algorithm applies:

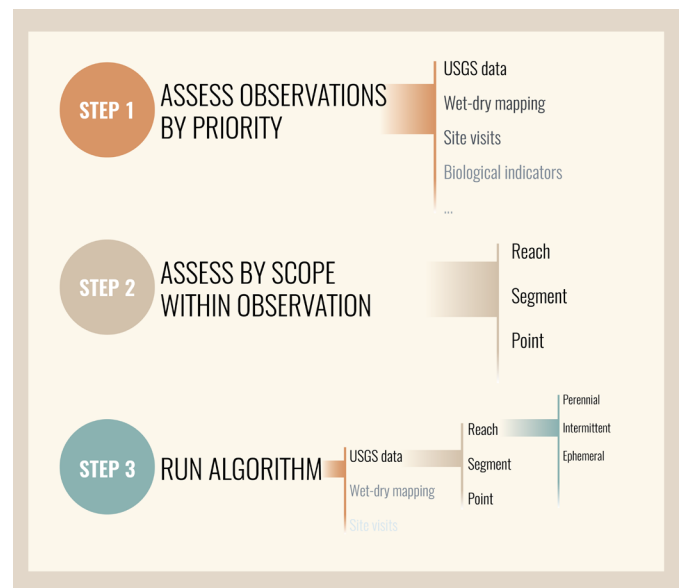
- Types of observation data where measured flow data (e.g. USGS stream gauges) and on-the-ground observations (e.g. wet-dry mapping, site visits and flow measurements by staff) receive greater weight for scoring over other indirect data (e.g. satellite imagery review, modeling)
- Scope where data that indicates a flow regime along the entire segment receives a greater weight than for data that are related to a partial area or point on the segment.

### Adding Data and Observations to GIS

New data and observations relating to the WBID's flow regime may be gathered by ADEQ stream monitoring activities, a request for additional information in a specific location, a third party notification of an existing data source, or records submitted by volunteer citizen scientists. New flow data undergo quality control checks to verify credibility. Credible data are compiled in tabular format and combined with all existing data in the GIS observation table for priority analysis using

the algorithm. The designations are determined by full consideration and prioritization of both the new and previously known data and observations for the WBID.

### ALGORITHM STEPS



For more information, visit [azdeq.gov/flowregimes](https://azdeq.gov/flowregimes).

To request the ADEQ GIS files for flow regimes, fill out an online request form through the ADEQ Records Center at [azdeq.gov/records-center](https://azdeq.gov/records-center).

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## How the Algorithm Works

**Step 1:** Assign Observation Priority | Observation data types with higher accuracy receive greater weight

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1. USGS or other agency gauge flow series, direct | Flow regime assigned from the streamflow gauge data within the WBID
2. Field surveys | Streamflow Duration Assessment Method (SDAM) using biological, soils and vegetation factors to determine flow regime for a WBID; wet-dry mapping noting the percentage of wet/dry segments to determine the flow regime status
3. Site visit by ADEQ staff | Field visit to the WBID to sample water, measure flow, and/or collect images of flow
4. Biological indicators present (macroinvertebrates, riparian vegetation, algae) | Results of biological observations or the collection of biological samples on the WBID
5. USGS or other agency gauge flow series, indirect | Extrapolate flow regime for the WBID from flow gauge data located on an adjacent WBID or bracketing the WBID
6. GIS/imagery review | Analysis of existing datasets (i.e. Google Earth, National Agriculture Imagery Program, other remote sensing imagery data sets)
7. Site report (Arizona Water Watch) | ADEQ citizen science program for surface water observations and monitoring by volunteers; more info at <http://azdeq.gov/azww>
8. Historical source reporting | Observations originating from various sources mostly pertaining to perennial and intermittent waters prior to the application of GIS (i.e. observations by Arizona Game and Fish Department)
9. Modeling | Computer modeled flow, not directly using gauges but various other sources derived from interpolation/extrapolation of data sets, modeling flood events and flows, etc.
10. Other | Data not in one of the above categories (i.e. U.S. Corps of Engineers determinations, case studies, etc.)

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LOW

If multiple data records of different flow regimes exist in the same Observation Priority data type, the most recent data source is used to assign the flow regime

**Step 2:** Assign Scope Priority | Evaluate the level of spatial extent for the Observation Priority data type with the greatest scope (the entire reach) ranking highest

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1. Reach | Data spans across the entire length of the WBID
2. Segment | Data spans across parts of the WBID
3. Dynamic - Segment | Data spanning multiple years across parts of the WBID (e.g. wet-dry mapping over more than one year)
4. Point | Data for a specific point location within the WBID (smaller than segment)

**Step 3:** Run the algorithm, which assesses the Scope Priorities in the highest Observation Priority and subsequently moves down the rankings until all data is reviewed

The weight of evidence is considered when assigning a flow regime. Assumptions include, but are not limited to:

- If the highest Scope Priority is achieved in the highest Observation Priorities, the algorithm will assign a flow regime of perennial, intermittent, or ephemeral
- If the highest Scope Priority is achieved in lower Observation Priorities, the algorithm will assess the weight of evidence in lower Scope Priorities for higher Observation Priorities to determine if flow regime can be assigned
- If no Observation Priority achieves greater than 50% of the highest Scope Priority, then the WBID is assigned 'Undetermined'
- If there is no data for the WBID, it is assigned 'Null'